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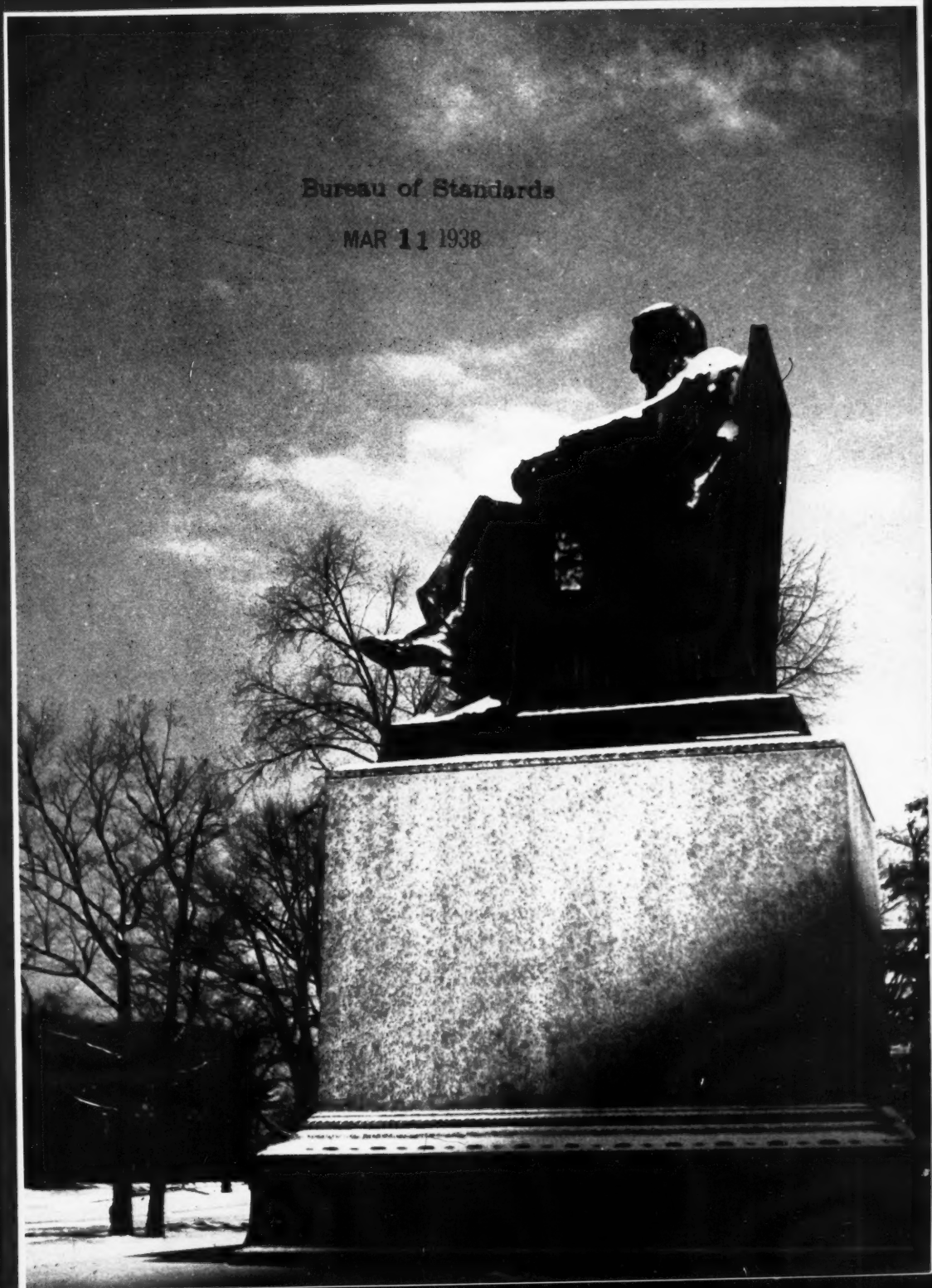

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MANUFACTURE OF TELEPHONE CABLE

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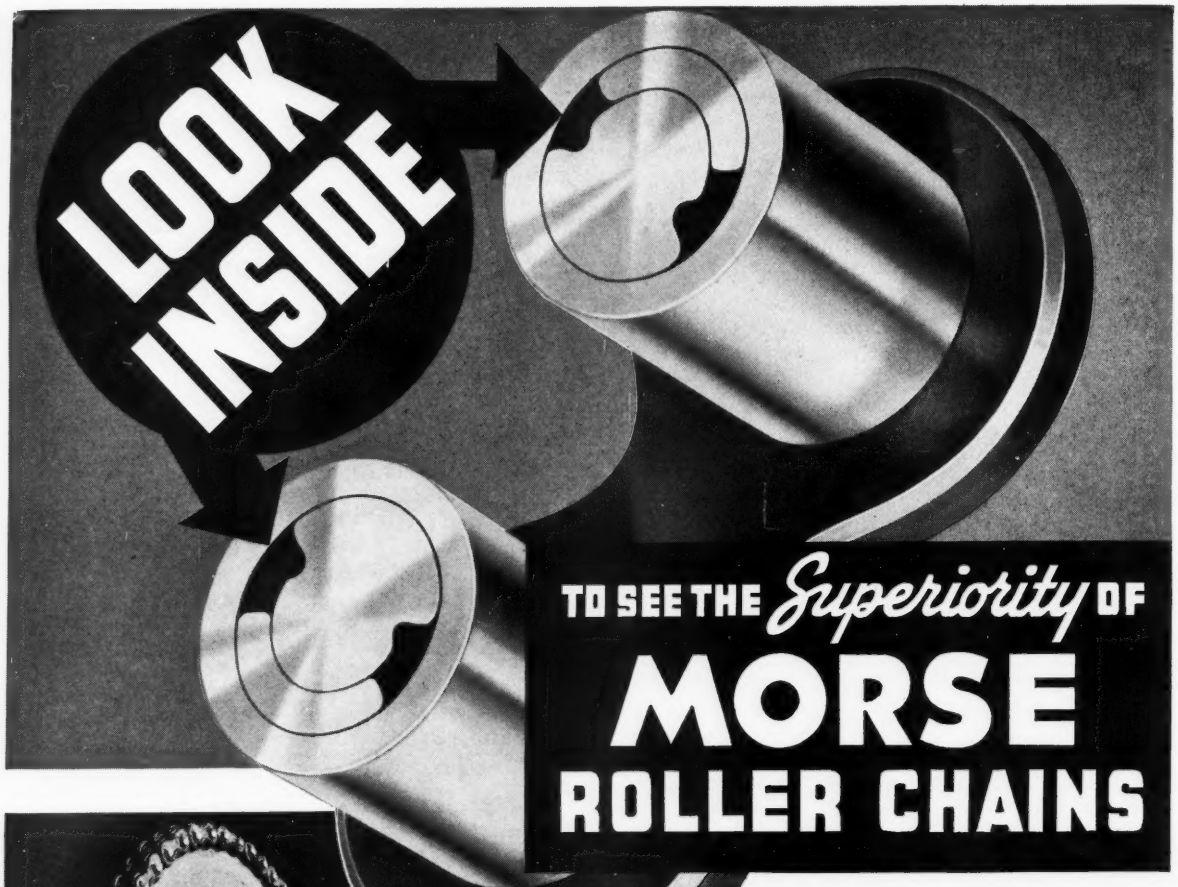

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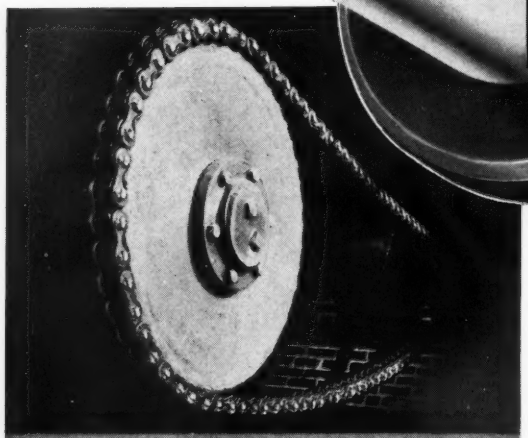

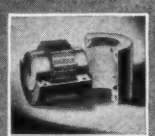

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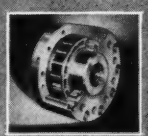

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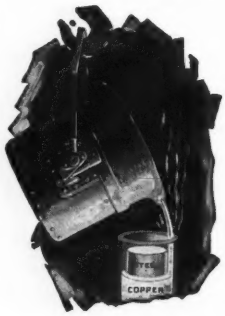

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THE CORNELL ENGINEER

PUBLISHED MONTHLY DURING THE COLLEGE YEAR

Volume 3 | FEBRUARY 1938 | Number 5

COMMENTS

The engineer turns to a study of human comfort. Professor W. M. Sawdon, '08 MME, discusses some fundamentals to be considered in conditioning buildings for human comfort.

"Development of Portland Cement" by A. F. Underhill '30 CE, traces the history and growth of the Portland Cement Industry and the use of concrete for modern homes.

Robert G. Irish, '40 AE, describes present-day cable production in "Manufacture of Telephone Cable."

Our center spread introduces Professor F. H. Rhodes, as Director of the new Chemical Engineering School, recently incorporated into the College of Engineering.

Our cover is a striking photo of the statue of Andrew D. White, first President of the University, taken by Norman Herr '37.

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Andrew D. White.....Cover

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Testing Toll Telephone Cable

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Air Conditioning For Human Comfort

PROF. W. M. SAWDON, '08 MME.
Professor of Experimental Engineering

In order to understand just what are the requirements which must be met in the surroundings of the human body so that comfort, so far as heat is concerned, may be experienced, it is well to consider a few well-known facts. The human body may be likened to a heat-generating machine in which the food eaten constitutes the fuel and the air breathed furnishes the oxygen for combustion.

In the process of metabolism which is continually going on within the body, heat is being generated at all times, and since the internal temperature of the body must be maintained practically constant at 98.6°F, it is necessary that this heat be dissipated at nearly the same rate as it is generated. Any considerable change in the internal body temperature is accompanied by danger and a few degrees increase above the normal, or a small decrease below it, is likely to prove fatal. Since the body is subject to surrounding temperatures covering a range of well over 100 degrees and it must still maintain a constant internal temperature, it must be provided with a most remarkable temperature control. This is not entirely understood, but it is known that the rate of metabolism changes unconsciously with the demand for heat within the body and that the surface of the body may change from a fairly good insulator of heat to a reasonably good conductor of heat.

The manner in which this is done is illustrated in Fig. 1, taken from "Public Health Engineering," by Phelps. A, in this figure, represents a condition in which the air temperature is much lower than is the blood temperature; the capillary blood vessels lying close to the skin are collapsed and the flesh between the skin and the arteries and veins forms an insulating material which allows the skin to become much cooler than the blood. Now, since the heat loss from the body is dependent upon the difference in temperature between the surface of the body and the air, the heat loss is less as the skin surface becomes cooler. The heat loss for the particular condition here shown would take place by convection and by radiation. In B, of the same figure, the temperature difference between the blood and the air is smaller. Blood is now circulating through the capillary tubes and the skin is kept warm allowing it to dissipate heat more rapidly. In this case, the heat may be carried away by convection, by radiation, and by evaporation of the perspiration carried through the pores of the skin. In C of Fig. 1, the temperature of the air is the same as that of the blood; blood is circulating through the capillaries so that the skin is warm, but no heat can be carried away by convection because the air is as warm as the skin, and the only ways by which heat may escape from the body are by radiation and by evaporation.

If, when the temperature of the air is the same as that of the blood and the objects surrounding the body, such as the walls of a room, are at the same temperature as that of the air, then it is evident that the only avenue left for the escape of heat is by evaporation. If, under these conditions, the space surrounding the body were to become saturated, that is, if the relative humidity were to become 100 per cent, then no heat could escape from the body and the internal body temperature would increase producing fever.

Consideration of these principles makes it easy to explain the reason for the tragic death in such instances as that which occurred in the "Black Hole of Calcutta," after the fall of Fort William, when 146 English soldiers were crowded into a small basement room, with but two small grated windows, on a hot June night and 113 of them died before morning. This with other similar, although less tragic, incidents gave color to the common belief of the time that a toxic substance was given off with the breath of man and other animals. This belief was further greatly strengthened by an eminent physician, Dr. Brown-Séquard, who, during the period between 1880 and 1890, published the results of various crude experiments; one of which was made by connecting a series of air-tight chambers with small tubing, leaving the last chamber open to the atmosphere and the first connected to an air-supply pump. A mouse was then

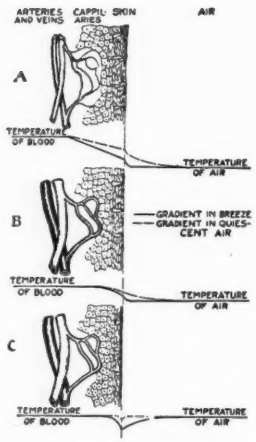


Fig. 1. Diagram of thermal gradients through the skin and hair. A, cool air; B, warm air; C, air at body temperature.

placed in each of these chambers and air was continuously pumped into the first chamber from which it passed successively through the other chambers and finally to the atmosphere. The mouse in the last chamber soon died and the others died in succession up to the first which did not die. The Doctor concluded that there was an accumulation of poison from the breath of the animals which naturally increased from the first to the last. He then condensed the vapor from the breath of men and also from dogs and injected this condensate under the skin of rabbits with the result that the rabbits died. The results of these experiments were given wide publicity since the Doctor lectured extensively before various medical groups in continental Europe, Great Britain, and the United States. Numerous unconvinced scientists in these countries set about to check the truth or falsity of these conclusions with the result that two of the most comprehensive and thorough-going sets of experiments were conducted; one at Wesleyn University, Middletown, Connecticut, and reported in 1907 in a bulletin of the U. S. Department of Agriculture, and the other in the Physiological Laboratory of the London Hospital Medical College and reported in the Smithsonian Miscellaneous Collection in 1913. These experiments proved conclusively that there is no poisonous or toxic substance given off in the breath of healthy animals and that carbon dioxide, the natural by-product of respiration, is not injurious.

The rabbits in the experiments of Brown-Séquard had died from the shock of cold liquid injected into the bodies and it is probable that the mice died from inability to dissipate heat from their bodies or, possibly, from lack of oxygen.

In 1914 the Chicago Commission on Ventilation published a report upon a series of experiments dealing with the effects on human comfort of the relation of air temperature to the moisture content of the air. Included in their report was a "Comfort Chart" shown in Fig. 2. This chart was heralded as an important discovery and it received wide publicity. The American Society of Heating and Ventilating Engineers, having established a research laboratory at Pittsburgh, in cooperation with the U. S. Bureau of Mines, took up this problem and spent several years in perfecting and extending the data so as to show, through a large range, the effects of various combinations of temperature, humidity, and air motion upon the sense of heat as experienced by the human body. The results of their studies were plotted by superimposing the lines of constant heat effects, which they found, upon the standard psychrometric chart. Fig. 3 shows the chart for still air and similar charts were constructed for air moving at definite velocities. The more oblique lines, in this figure, are wet-bulb temperature lines while the less oblique lines are lines along which the human body has a sense of constant temperature. These latter lines were named *effective temperature* lines. In reality, that which is called effective temperature is not a temperature at all, but may be defined as a measure of the sense of temperature experienced by the human body as a result of any combination of temperature, humidity, and air motion.

Emphasis should be here placed upon the fact that an effective temperature which may be most favorable for comfort (sometimes spoken of as optimum effective temperature) in one room may not be satisfactory for the same purpose in another room. If the walls of the one room are insulated and the windows double-glazed so that they are reasonably warm and the walls and windows of the other room are cold, then to make

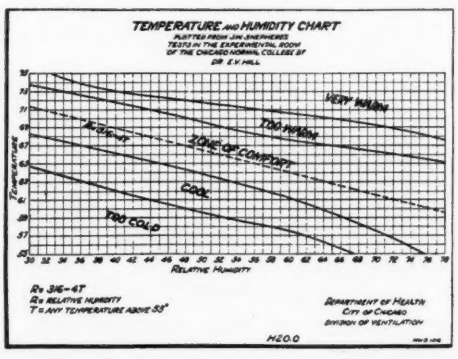
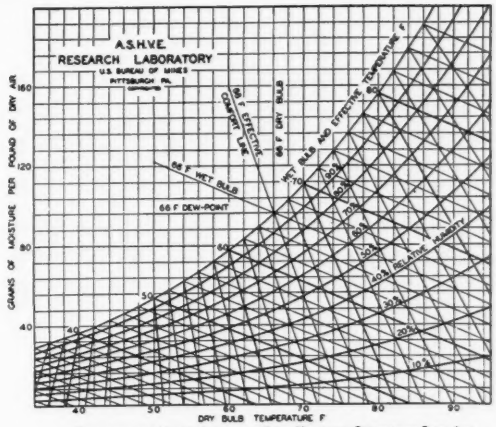


Fig. 2. Curves showing relations of temperature and humidity to comfort.

a person comfortable in the room with the cold walls the effective temperature in this room will need to be higher than that for the room with warm walls.

This fact, together with some knowledge of experiments which have been reported from various sources leads to speculation as to what the future holds, especially in the field of summer cooling. Wherever possible, it would be cheaper to cool radiant surfaces, such as panels in the wall, so that the bodily heat would be dissipated by radiation to these surfaces, than it would be to cool the air so as to produce the same comfortable condition. There is much to be done to learn what temperatures and what distribution such surfaces should have to be most effective, but the possibilities of this kind of cooling seem great. This system is analogous to the system of panel, or radiant, warming that is so popular for the better class of buildings in England.



PSYCHROMETRIC CHART, PERSONS AT REST, NORMALLY CLOTHED, IN STILL AIR

Figure 3

Development of Portland Cement

A. F. UNDERHILL, '30 CE.

The portland cement industry is one of the largest basic industries in the United States. Because of its size and the various uses of its products it can count practically one hundred per cent of the population among those who have, and are, receiving the benefits which this industry has made possible.

Portland cement is not what we of today might term a recent product, but compared to the span of the history of man it is indeed new. The cements used in the days of the Roman Empire were composed of slaked lime and volcanic ash. These materials were not used to make mass concrete, but only as a mortar for binding together the building stone. When this Empire went into a decline, the small knowledge of mortar was lost and it was not for many centuries that it was again used as a building material.

In 1756 in England, a man by the name of John Smeaton constructed a lighthouse in the English Channel with a hydraulic cement which he prepared from impure limestone and clay. This product was, as before, used as a mortar to bind the stone together and not in making mass concrete. The use of mortar alone continued until the early part of the nineteenth century when an English bricklayer, by name Joseph Aspidin, discovered after a series of experiments, that certain amounts of limestone and clay, when mixed, burned, pulverized, and combined with water would harden into a material very much like stone. This "stone" looked so much like a building stone that was quarried on the isle of Portland that he named his product Portland Cement. He obtained a patent on this discovery and the portland cement industry began. Between the years 1855 and 1860, William Aspidin, son of the inventor, built a concrete wall around his home in England and that wall is still in an excellent state of preservation today.

Because of the uses which men of imagination and foresight could see for this product, the spread and growth of the industry was rapid. In 1872 the first plant for the manufacture of cement was erected in eastern Pennsylvania. The industry began to grow here and in 1880 the production of portland cement in this country was 42,000 bbls. In 1898 the production in this country had increased to 5,000,000 bbls. After the year 1900 became a reality, the portland cement industry really started to grow in volume until, in 1936, cement was manufactured in 35 of our 48 states by 149 plants, which have a total production capacity of 267,400,000 bbls. The consumption of cement has, however, never reached capacity production. In 1928,

which was the peak consumption year, there were 175,800,000 bbls. used in the United States. This gradually dropped off to the low total in 1933 of 64,-000,000 bbls. and has gradually advanced to 112,566,-000 bbls. in 1936, which amount is about forty-one per cent capacity production.

Not all of the cement consumed in the United States has been produced here even though the industry has never been able to sell its capacity production. Portland cement is imported into this country from Japan, Belgium, Denmark, Germany, Netherlands, Norway, Poland, and Yugoslavia. These imports have been constantly increasing and becoming more of a menace to our own companies because of their cheaper price. We cannot hope to compete with these foreign manufacturers because of the very wide difference in standards of labor. It is hoped that this condition will be remedied through a revision of our reciprocal trade treaties which at the present time allow portland cement to come into this country with too great a lack of tariff.

At this point in the discussion a glimpse into the marketing policy of the industry would be quite appropriate.

The portland cement which is manufactured in this country today is a uniform product which conforms to all the standards of the individual state laboratories, the United States Bureau of Standards, and the American Society for Testing Materials. Since this is a fact, no buyer will pay any manufacturer a premium for his particular brand. Then the lowest price that is offered in any market becomes the going price. So the lowest price that any company offers at any particular point tends to bring prices of all other plants down to that level. Unless some plant offered a lower price, this lowest price, as in the case of many other standard articles, is the price below which no plant will go to obtain the business. As a matter of fact, the real meaning of competition is exemplified in this industry. In practically all instances the plants looking for business at a certain point are located at varying distances from that point. Different distances make different freight rates. Thus in shipping to a common consuming point at the going delivered price, each plant will receive a different net amount for the same quantity of like material. This, it seems to me, is real competition. Every consuming point in the country is solicited by several plants. This competition within the industry makes it possible for a buyer to purchase portland cement from any company or plant that he wishes.

The increase in the use of portland cement during the past twenty-five years has of course, been due to several reasons. One is the obvious adaptability of concrete in lieu of stone for foundations, walls, etc., because concrete can be moulded to fit into any shape desired with comparative ease, while stone has to be cut and trimmed to fit exactly into the required space. Many times this took long laborious hours of work with comparatively little total production being realized. Probably the most important factor in the increased use of concrete can be attributed to the Portland Cement Association. This is an organization of efficient, capable engineers whose duty it is to educate the public in general and the consumers in particular on the various uses of concrete. It is also their aim to sell the idea of the use of concrete on different types of work when this material comes into competition with steel, cast iron, asphalt, vitrified tile, brick or gypsum, which are, as you can readily see,

Single girder bridge, York County, Pennsylvania.

Spandrel Arch bridge over crook on Route 30 near Nineveh Falls, Clinton, Conn.

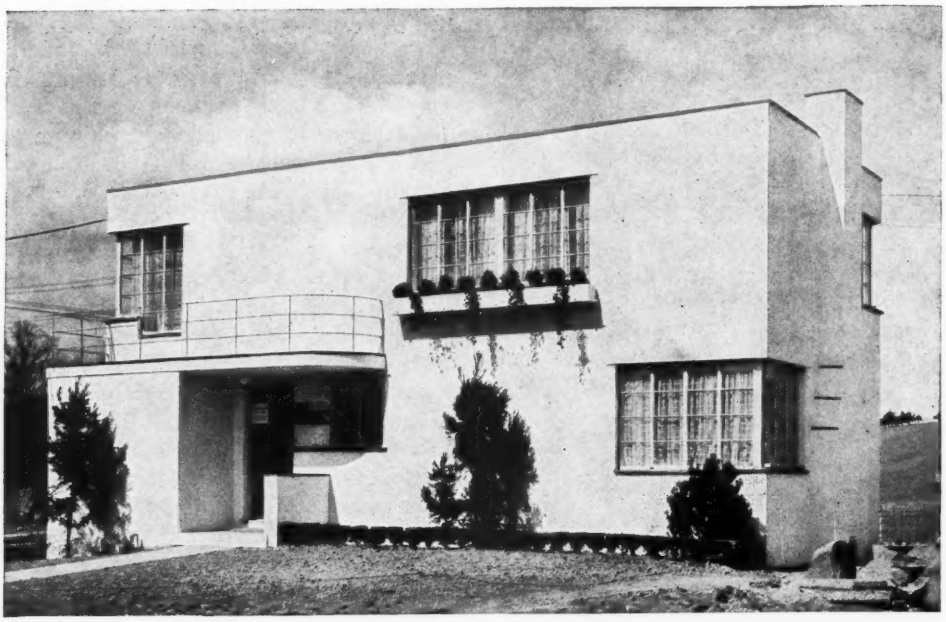
the competition to the cement industry.

In order to give you an idea of the competition which the industry has, let me name a few types of buildings on which the foregoing list enters into competition with portland cement concrete. In building class "A" highways concrete competes with bituminous macadam, asphalt, and brick. In constructing edifices such as large office or industrial or apartment buildings, concrete can be used in the foundations, the floors, and the frame. Cinder block can be used in the partitions and terazzo for the finished floor. The outside walls can be covered with portland cement stucco. The competitors of the industry can erect this building by using a steel frame, gypsum floors, mastic tile floor finish, vitrified tile for the partitions and a brick exterior. In bridge construction, concrete meets only steel in competition. In sewer work, concrete pipe competes with vitrified tile and cast iron. Since the competition between industries in the building line is so keen on all kinds of work, the price which has been, and will always be, charged for portland cement is regulated according to the prices of its competition. If the price of cement is too high, more steel frame and less concrete frame buildings, etc., will be built. So it is to the advantage of the industry to manufacture and market cement at as low a cost and small a profit as possible in order to have the public consume a large enough volume to insure low production costs and a steady income.

Portland cement has been to a very large extent responsible for the rapid growth of our structural world and has, of course, contributed greatly to the development of every part of the United States.

The use of concrete in building construction has been a major factor in making the southern states, particularly Florida, the winter playground of the United States. The tourist trade is Florida's life blood. During the days when dwellings of timber or brick veneer on frame construction were the only types of residences erected, the risk of investing money in them

Mid-South Cotton Growers Assn. Building, Memphis, Tenn. Reinforced concrete walls, concrete floors, architectural concrete exterior treatment.



Concrete House at Yonkers, N. Y.

was very great because at any time a hurricane was likely to sweep the state and take all the buildings with it. The introduction of concrete houses into this picture was a welcome guest indeed. These buildings, constructed of poured concrete or of cinder or concrete blocks, have withstood all the winds that Florida has produced since their introduction into the state. This has made it possible to invest in building with almost one hundred per cent assurance that no wind will steal the proprety. Thousands of these houses have been erected, so that thousands of people have made this state their winter home and many of this group have even made Florida their permanent residence. These permanent and winter residents have attracted tourists for short times during the winter. These tourists have made necessary the construction of hundreds of hotels and this, in turn, has meant more business in every line. In this present winter of 1937-38, Florida is enjoying the most prosperous season that it has ever had. So we can say without contradiction that the use of concrete in house construction has played a very large part in the present prosperity of Florida.

Let me add a few words about these concrete houses. As well as being weather resistant, they are constructed in styles and types which many consider the most beautiful architecture the modern world has produced. Because of the moulding properties of concrete practically every size, style, or shape of structure can be erected. In fact, a large part of the homes in use in the South are built in modern architecture, the replica of which we in the northern part of the country are just beginning to build. It is my conjecture that not many more years will roll by before nearly all of our small buildings will be of this weather resistant, fire resistant, permanent type of structure.

Another enormous project in which concrete has played a major role is that of flood control over the entire nation. The United States has, so far as we can determine, had floods periodically since the continent was formed. The extensive argicultural program of this country in the last twenty-five years has stripped the land of all the natural "sponges" which were provided for our safety. This has continued in many parts of this country until floods have been becoming more and more frequent. In fact, every year sees several floods that are responsible for great loss of life and property. The Federal Government is now working on a flood control system that will upon completion materially reduce the damage from floods. The various structures used in flood control work are dams, spillways, diversion tunnels, dykes, etc. All of these structures are made possible by portland cement concrete and flood control is therefore a project that one hundred years ago would have been impossible of completion. Here again concrete has been a vital force in giving security to the public.

Along the same line as the flood control projects are the irrigation projects in the dry portions of the West. Lands that were barren wastes before irrigation sysetems were introduced, have been utilized for the cultivation of crops. Most of these systems have as their mainspring a huge concrete dam which backs up the water of a river, thereby giving a constant

supply to the series of small ditches from which the land gets its water. Concrete has helped even the food supply of the United States.

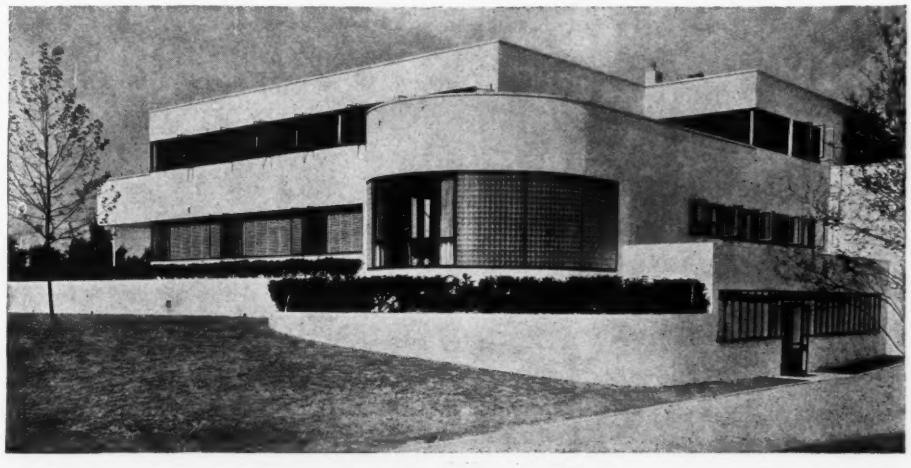
The automobile business is probably the largest manufacturing and marketing business in the world. Since the automobiles are a means of transportation they must travel on roads. Roads must be adequate for automobile traffic. The automobile business really started to boom when concrete roads became a reality. Again the portland cement industry contributed in a large extent to the growth and prosperity of an industry in which every living American is interested in some way or another.

Besides the aforementioned activities the cement industry has contributed to the health of every individual in the country. The concentration of population at various points in our several states has made the disposal of sewage, as well as storm water, a real problem. For years other materials were utilized in constructing both sanitary and storm water sewers. When larger sewers were needed to care for the increasing amount of sewage some new materials of construction were needed. This new material needed was discovered to be concrete. Sewers of large diameters were designed and built of poured in place concrete. Some of these sewers were laid down about 1900 and are, generally speaking, in good condition today. New York City's sewage disposal problem was by far the most complicated because of the large population in the small land area and it is safe to say that, if it had not been for concrete, this problem would not have been nearly so adequately and efficiently solved.

Concrete is, however, not just a material to be used for strength alone. In the preceding century the structures in this country, which included bridges and buildings, were built with merely the thought of usefulness in mind. This necessarily had to be so because about the only material that could be used to beautify structures was stone. This was costly to quarry and more costly to put in place. So we had to be contented with only the commercial needs. Now, however, with concrete employed, every structure that is designed is designed with a thought to its beauty as well as for its utility. This can be carried out because concrete is easily moulded into practically every conceivable shape. As a consequence, our structures of today are a mark of beauty on the landscape rather than just necessary eyesores as many of the old ones were. The old truss and girder bridge structures, while adequate for carrying loads, were not a mark of beauty, but the modern concrete bridges on both highways and railroads are structures of real beauty as well as utility. One example of this is the spandrel arch bridge near Clinton, Conn. As you can see by the picture, the citizens of Connecticut can be justly proud of its presence. Native stone is still used in a large degree for trim where the supply is available, but a much larger amount of synthetic stone is used to beautify structures. This synthetic stone is moulded from cement and aggregates and the results are excellent.

The Portland Cement Association in conjunction with several of the State Departments of Public Works have been working on new types of low cost roads. Some cement bound macadam roads have been built at low costs with ultimate satisfaction. In several southern states some roads have been constructed from ordinary earth and portland cement. Cores from roads look like concrete and so far these roads have proven very durable. This particular type of road is very inexpensive to build.

All of these uses to which concrete has been put go to make up the part that portland cement has played in helping to build the United States from a struggling group of individuals to the most powerful country in the world.



Concrete House at Mount Kisco, N. Y.

Manufacture of Telephone Cable

ROBERT G. IRISH, '40 AE.

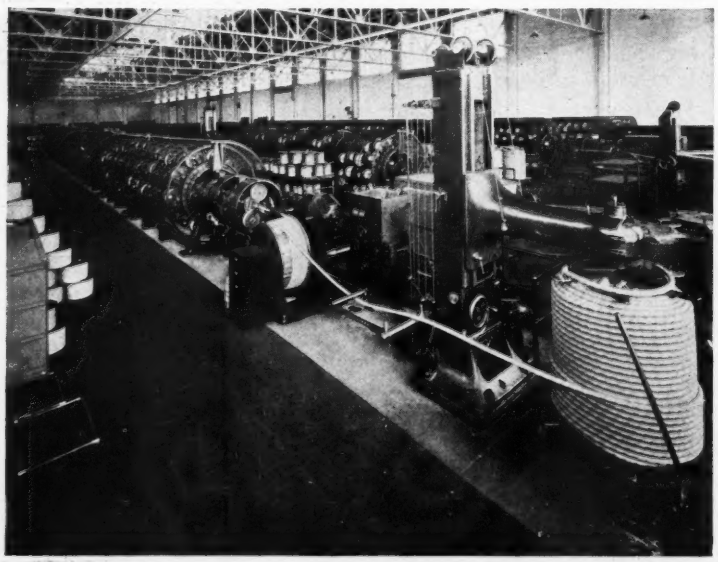
In the early days of the telephone there was no need for cable as the small number of wires used could be carried satisfactorily on poles. Owing to the rapid increase in the use of telephones, however, the number of wires grew so fast that it soon became impractical to carry them on poles. In New York City some streets were lined on both sides with the telephone poles bearing more than a dozen cross-arms, each carrying ten wires. The obvious solution was to insulate the wires and form them into some sort of cable. This idea was realized in 1880 when wires enclosed in a sheath were carried across the Brooklyn Bridge.

There were many difficulties encountered in the manufacture of early telephone cable. The number of pairs of wires that could be carried in the cable was small because of the type of insulation used on the wire. The cable had to be formed first, and then drawn into the sheath, as there was no way known to apply the sheath directly to the cable. About 1890, paper insulation was substituted for cotton and rubber, making possible a greater number of wires in the same sized cable. From about 1900 to 1920 there were many improvements in telephone cable. Improvements in machinery made possible the use of narrower and thinner insulating paper. The wire-drawing industry made many advances, constantly drawing finer and finer wire. A process for the continuous application of the lead sheath was developed.

About 1888, cable had fifty pairs of number 18-gauge wire. By 1902 we find 606 pairs of 22-gauge wire in a sheath of 2/3/8 inch inside diameter. By 1912, the number of pairs had increased to 909. In 1914, the first 1,212-pair cable using 24-gauge wire was used. Telephone cable as it is known today consists of pairs or "quads" (double pairs) of paper-covered copper wire built up into a cable and covered with a lead-antimony sheath.

Telephone cable falls into two classes: long-distance or "toll"-cable, and local-service or "exchange-area" cable. Long-distance cables connecting cities are often seen slung on poles as one drives through the country. Exchange-area cable is used within a city to connect exchanges and to connect subscribers with their exchange. This cable is usually placed in conduits beneath the street.

Toll cable, because of the larger currents the wires are required to carry, is made of heavier wire than is local cable. The wire used is number 16 to number 22-gauge copper. Strips of paper wound around the wire provide insulation. Large rolls of paper are placed in a machine which slits the paper into strips about one-half inch wide and winds the strips into rolls or disk-



Cable stranding machine which is used to produce layer type cable.

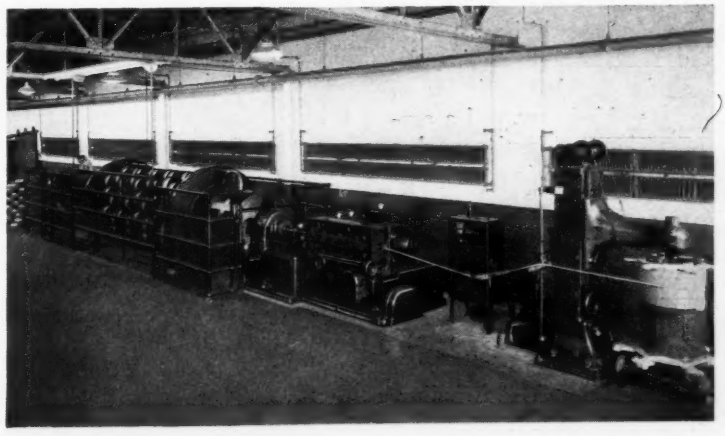
shaped pads 12 inches in diameter. The paper used is manila-rope wood-pulp paper. The pads of paper and reels of wire are placed in a machine which winds the paper spirally on the wire at a speed of from 1,470 to 3,000 R.P.M. Paper of different colors is used to insulate the wires so that different color combinations may be used in later processes. After insulation the wire is passed through a polisher.

The insulated wires are next placed in a machine which first twists the wire into pairs with a two to six-inch twist and then twists two pair into what is known as a "quad". This machine twists and quads wire at the rate of 50 feet per minute.

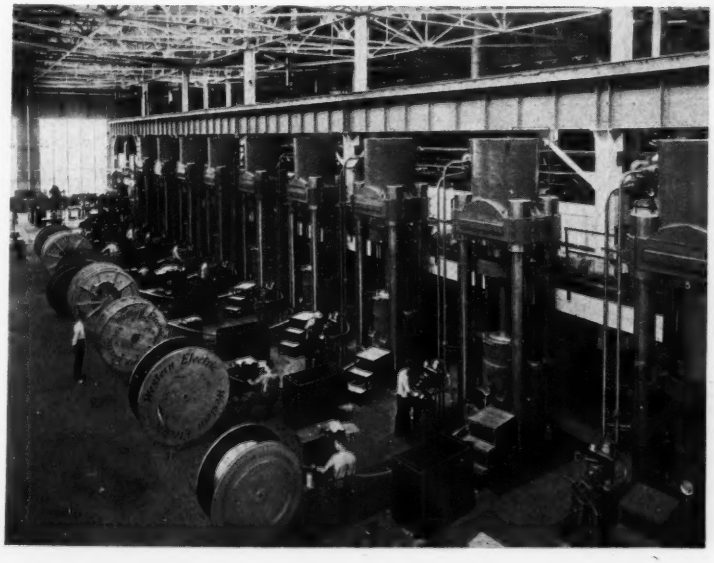
The next operation is that of stranding the quaded wires into cable. The machine used for this operation is called a "drum strander". The cable is built up in layers. Starting with a single quad, the quads are laid on in alternate layers as the cable progresses through the machine. One layer is applied on another until the required number of layers is obtained. The strander consists of a number of drums. The number of drums used depends on the number of layers in the cable. Each drum carries a number of reels of quadded wire corresponding to the number of quads in that particular layer. A single quad starts at one end of the machine. Each successive drum applies a layer of quads until the final desired number of layers is obtained. An outer wrapping of paper is applied to the finished cable to help keep the wires in shape and to provide additional insulation from the lead sheath. This stranding machine can produce cable at a speed of up to 100 feet per minute.

To be a good insulator for the conductors of a telephone cable, the paper must be bone dry. Paper picks up moisture very rapidly. 1000 lbs. of loosely packed paper will take up 90 lbs. of moisture in a few hours. To thoroughly dry the paper, the stranded

(*Continued on page* 128)



The flier strander. This machine produces units for unit type cable.

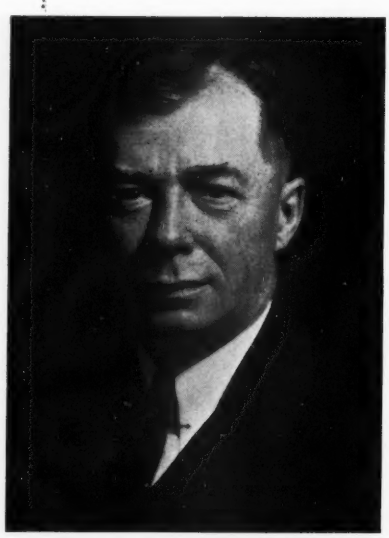


The lead presses used to apply the lead sheath. The de-humidified cable storage room is located directly behind these presses.

THE NEW CHEMICAL N

Degree of Bachelor of Chemical Engineering
now offered by
College of Engineering

THE ESTABLISHMENT of a School of Chemical Engineering, effective July 1, has been approved by the University Board of Trustees. The new school will be a constituent unit of the College of Engineering, coordinate with the existing School of Civil Engineering, Sibley School of Mechanical Engineering, and School of Electrical Engineering. The new school is the outgrowth of a series of courses given in the past 27 years, during which there has been a steadily increasing demand for chemical engineers on the part of industry, and a consequent increase in the number of students desiring technical training in this field.



Prof. F. H. Rhodes

Professor F. H. Rhodes, who has been chairman of the joint committee supervising the chemical engineering curriculum, will become director of the school, assisted by Dr. C. C. Winding, instructor in chemical engineering. Two professors from the Department of Chemistry, Dr. C. W. Mason, optical chemistry, and Dr. A. W. Laubengayer, inorganic chemistry, will have seats as voting members on the Chemical Engineering faculty, as will two professors from the Sibley School of Mechanical Engineering, W. N. Barnard, heat-power, and A. C. Davis, experimental engineering.

New Director Experienced

Professor Rhodes is a graduate of Wabash College, receiving the A.B. degree in 1910 and the Ph.D. degree from Cornell in 1914. After several years spent in teaching at the University of Montana and at Cornell, he was research chemist and chemical engineer and director of research of the chemical department of the Barrett Company. He also acted as consultant for the Anaconda Copper Company, the Atlantic Tar and Chemical Company and other industrial concerns. He designed the refined products section of the main tar refinery of the U. S. Steel Corporation at Clairton, Pa. The holder of several patents covering improvements in refining coal tar products, he is vice-president of Rhodes and Schnee, Inc., of Cleveland, Ohio, dealers in chemical products.

Since 1920 he has been professor of chemistry and chemical engineering at Cornell and has been chairman of the committee supervising the curriculum in chemical engineering since its establishment. He is the author of "Patent Law," 1931, and of more than fifty articles on chemical and chemical engineering subjects in various technical journals. He is a member of various professional societies and of Phi Beta Kappa, Sigma Xi, and Alpha Chi Sigma.

New Degree Offered

The curriculum of the new school will consist of a five-year course leading to the new degree of Bachelor of Chemical Engineering. The facilities of the modern $1,500,000 laboratory given to the University by the late George F. Baker will be coordinated with those of the College of Engineering to train men, not only in chemistry but also for the design, development, and operation of actual producing units in chemical plants.

The expansion of work in chemical engineering at Cornell has been rapid in recent years, corresponding with demands from the chemical industry. The first step in this direction was taken in 1911, when a four-year curriculum leading to the degree of Bachelor of

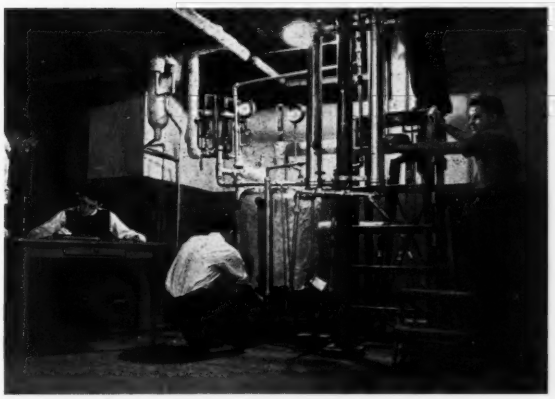
L NGINEERING SCHOOL

Chemistry was set up by the College of Arts and Sciences. Although designed primarily to train chemists, this curriculum included required courses in mechanics, mechanical engineering, and electrical engineering, and many of the graduates actually became chemical engineers.

Work Long Established

Instruction in the specific field of chemical engineering dates from 1920, when several courses in industrial chemistry were first offered. When the Baker Chemical Laboratory was occupied in 1923, special laboratory facilities became available for chemical engineering, and laboratory courses in this field have been offered since that year.

In 1930 a five-year course leading to the degree of Chemical Engineer was organized, administered jointly by the Department of Chemistry and the College of Engineering. Candidates for this degree were registered for the first four years in the College of Arts and Sciences, at the end of which time they became Bachelors of Chemistry. In the fifth year the students registered in the College of Engineering and received the degree of Chemical Engineer. A special coordinated five-year curriculum, including chemistry, engineering, and chemical engineering, was provided. Since 1935, all chemical engineers have been registered for the entire five years both in the College of Arts and Sciences and in the College of Engineering.

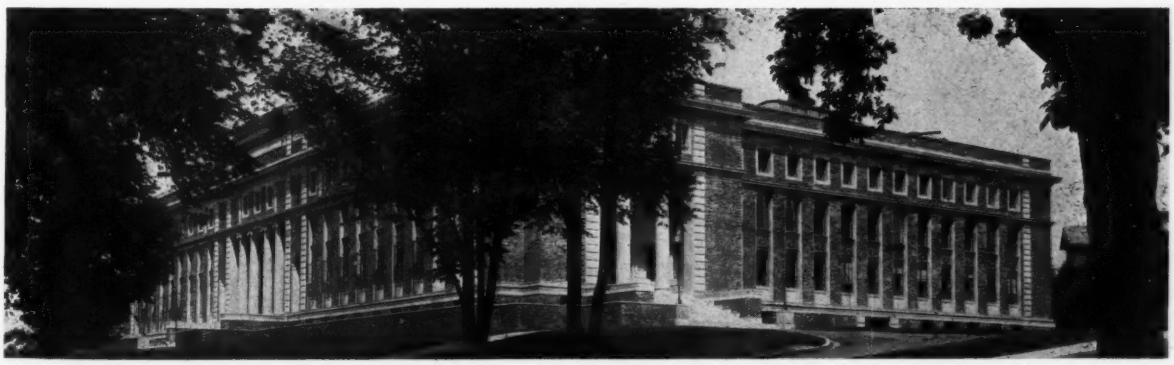


A group of Chemical Engineers at work in the laboratory.

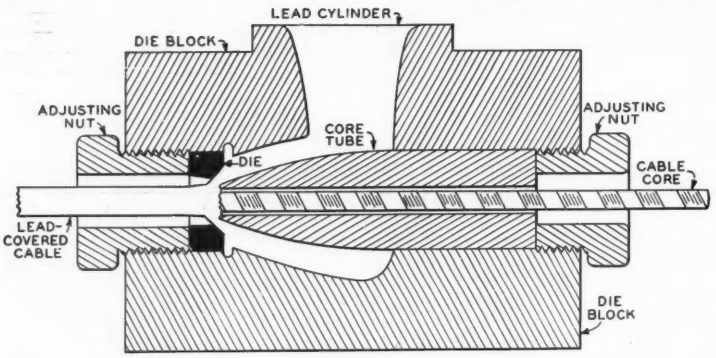
Enrollment Increasing Rapidly

In 1932 three seniors took the Chemical Engineering degree. This year there will be 14, and the total number of men registered in all five undergraduate classes is 158, of whom 78 are freshmen. Graduates are accepted by industry as having the equivalent of a master's degree from other universities, and all but one of the Cornell graduates in this field now hold responsible technical positions in the chemical industry. Last year each senior had an average of four offers of positions.

Cornell's chemical engineering curriculum is approved by the Engineering Council for Professional Development and the American Institute of Chemical Engineers.



The Baker Laboratory, home of the Department of Chemistry, used by Chemical Engineers for laboratory work.



Cuts by Courtesy of the Bell Telephone system Technical Journal.

Fig. 1. Cross section of die block.

(*Continued from page* 125)

cable is dried in a vacuum dryer. The drying ovens used are horizontal, cylindrical tubes, about 40 ft. in length of 8 ft. in diameter. The loading end of these ovens is located in the cabling room while the unloading end is located in a dehumidified cable storage room. The cable is left in the drying ovens for from 12 to 24 hours depending on the type of the cable. A temperature of 270°F, and a vacuum of less than 29 inches of mercury is maintained in the ovens.

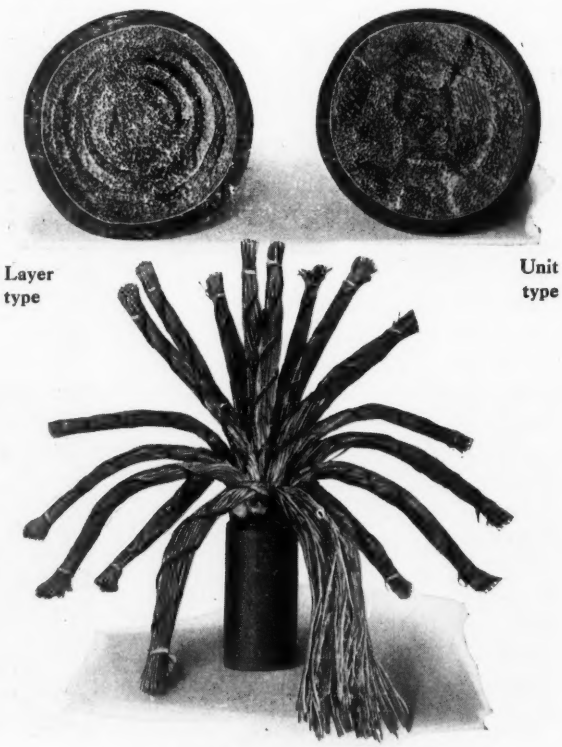
The dry cable is stored in this dehumidified storage room so that no moisture will get back into the cable before the lead sheath is applied. The air in this room is maintained at about 100°F. and a relative humidity of less than one percent.

The cable passes directly from the storage room to the lead presses which apply the lead sheath through a tube designed to minimize any exposure to the outside air. The illustration Figure One shows the principle of applying the lead sheath to the cable. The cable passes through the core tube and upon reaching the end, the lead is forced around the cable and is reduced to the proper size by the die. The sheath is about one-eighth of an inch thick. The lead is applied to the cable under a pressure of 54,000 lbs. per square inch.

The finished cable is wound on wood or steel reels. A full reel may weigh 10,000 lbs. The largest size cable made at present is two and five-eighths inches in diameter. There are about 300 feet on a full reel. These reels are rotated by power-driven floor rolls in taking up the cable. Each wire of the cable is tested for continuity before and after the application of the lead sheath.

Until recently, exchange cable was made in much the same manner as toll cable. Limited by the size of conduits beneath city streets, telephone engineers had to resort to the use of finer wire to get more wires in a cable. Wire up to number 26-guage is used. Because of the short distances involved, the use of fine guage wire is not objectionable. The largest exchange cable in use today contains 1818 pairs of number 26-guage wire. Quads are not used in exchange cable. Two new developments have changed the manufacture of exchange cable materially. These are the development of a process to apply wood pulp directly on the wire to form a continuous paper sleeve and the development of the unit cable in which units of up to 101 pairs of wire are stranded together to form the cable.

The material used in this type of insulation is Kraft pulp. It is prepared for use in the paper machine by beating as in the ordinary paper manufacturing process. The pulp, however, is used in a somewhat more dilute form than in ordinary paper making. The insulation process consists of forming simultaneously on a cylinder paper machine 60 narrow continuous strips of paper, each containing a wire. The moisture is pressed



Layer type

Unit type

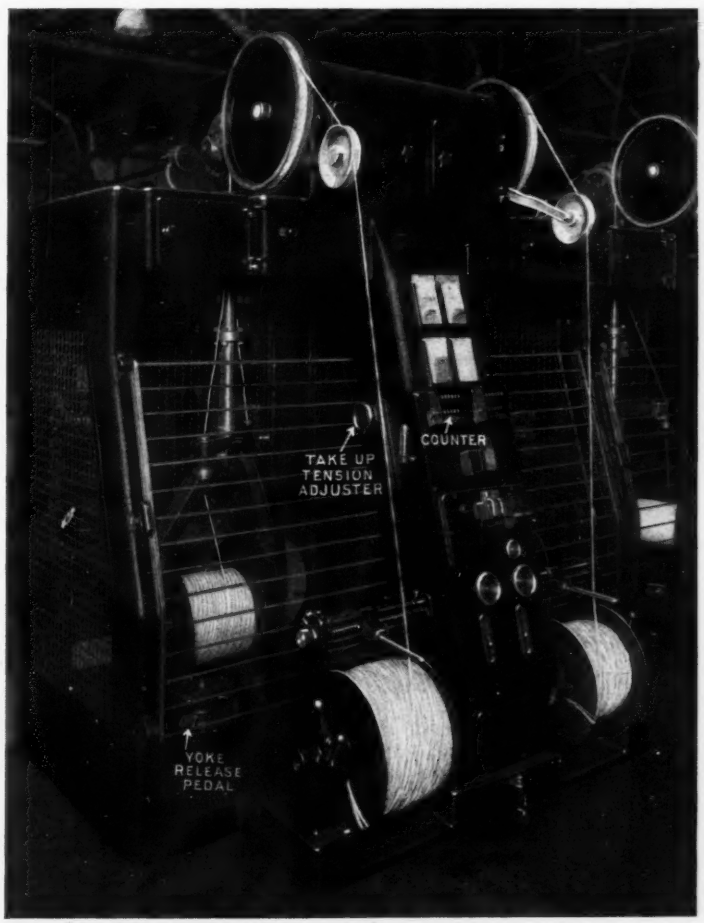
1818-pair unit cable

form the sheets and they are passed through a polisher which forms a uniform cylindrical coating of wet pulp around the wire. The remaining water is removed by drying. As the machine can not be shut down to change supply spools of wire, the wire is removed from the spools by a flier without rotating the spool. Thus the end of the wire of one spool can be brazed to the beginning of the next without removing the spool. The wire used has been passed through an alternating-current electrolytic cleaning bath to give it a clean surface. A narrow sheet of pulp is formed on an ordinarily single-cylinder paper machine; 60 strips of celluloid divide the paper up. The operation is so arranged that part of the strip is formed before the wire comes in contact with it and the rest is laid on top of the wire. The resulting narrow ribbon of paper has the wire imbedded in it. After passing through two sets of rolls which press out the moisture, the wire-imbedded pulp-strips pass to the polishers which rotate around the wire, forming the pulp into the cylindrical coating. The wires pass into a drying oven and thence to the take-up spools. There are two spooling positions for every wire so that the wire may be shifted to an empty spool from a full one. An electrical bare-wire-detector is provided to indicate any break in the insulation of any wire.

In the unit-type cable, up to 101 pairs are stranded into individual color groups known as units. A cabling machine then assembles a number of these units into a round core form. The pulp insulated wire after being twisted into pairs and wound on reels is put into a machine called a flier strander. This machine consists of a drum holding the required number of reels. A pulling mechanism pulls the pairs from the machine while a flier rotating about the machine strands the unit. A cotton thread is wound about the finished unit as it emerges from the machine. This strander produces the unit at the rate of 300 feet per minute. The units go next to the cabling machine. Here a number of supply strands are provided to hold the unit reels. The units are pulled through a distributor plate and twisted by a rotating take-up. The cabled units are then covered with a protective wrapping of paper as is the layer type cable. This type of construction has made possible the 1818-pair cable. The unit cable passes through the same subsequent processes as the layer type cable.

The telephone cable has passed through many developments. Developments in manufacturing have made possible the inclusion of more and more pairs of wires in cable. Such electrical difficulties as cross-talk etc. have been eliminated. We have today the unit type cable containing 1,818 pairs of number 26-guage wire within a sheath of two and five-eighths inch outside diameter. This is the largest diameter cable that can be made as the conduits already laid beneath city streets will not hold larger cable. As there is a constant demand for more wires, more wires must therefore be put in the same sized cable. Experiments are being conducted with even finer wire than is used today and we may expect to see in the near future, cable containing 2,400 pairs of wires.

The author thanks the "Western Electric Company Inc." for help and cooperation in preparing this article.



Combined twisting and quadding machine

COLLEGE NOTES

RADIO AT CORNELL

Nearly 200 students at Cornell are receiving training in the scientific and technical phases of radio, most of them students in the College of Engineering.

In the School of Electrical Engineering 40 juniors are registered in the basic course in electronics given by Professor W. C. Ballard Jr., and 21 seniors, representing 90 per cent of the class, have elected the senior option in communications, which is primarily concerned with radio. More than 100 underclassmen are members of the Radio Club, established last fall.

Twelve seniors are now members of a special course in broadcast engineering given by Mr. W. D. Moeder, instructor in electrical engineering, where they get actual practice in the technical operation of the University's broadcasting station, WESG.

Besides the regular programs originating on the campus the station has done emergency broadcasting, both local and national, during floods, sleet storms, and blizzards.

CHINESE STUDENTS VISIT SAYRE YARDS

Along with Dr. Rettger and Professor Perry, twenty-two student members and President C. H. T'ang of the Cornell chapter of the Chinese Institute of Engineering recently made a field trip to the Sayre, Pennsylvania, Shops of the Lehigh Valley Railroad. They made the trip on the line's "Black Diamond" through arrangements with Mr. Alfred Kittler, Division Passenger Agent, and Mr. R. L. Sullivan, Traveling Passenger Agent.

At Sayre they inspected the Car and Locomotive Shops under the supervision of Mr. E. E. Allen, Superintendent of Shop Costs, Mr. J. T. Maloney, General Roundhouse Foreman, and Mr. B. H. Duggan, General Foreman, all of the Lehigh Valley Railroad. The party enjoyed a comprehensive survey of the maintenance depot of this Company.

PROFESSOR AWARDED PLAQUE

Professor C. L. Walker of the School of Civil Engineering has been awarded the Kenneth Allen Plaque by the New York State Sewage Works Association for the best paper on sanitary engineering research delivered at the 1937 convention. His article, "Studies with Activated Carbon in Sewage Sludge Digestion," based on research conducted at Cornell in 1935 and 1936, was published in the Sewage Works Journal for March, 1937.

At the recent meeting of the state association in New York City, Professor William E. Stanley of the School of Civil Engineering was elected a director. Professor Walker is a past director of the association and is now a member of the committee on research. He has also been a member of the short school committee and the committee on publications. Professor Emeritus H. N. Ogden, of the School of Civil Engineering, is also a past director.

Fred J. Biele, who took his C.E. degree at Cornell in 1909, was elected president of the New York State Sewage Works Association at the same meeting. He lives in Huntington, N. Y.

OUR COLLEGE IN THE NEWS

Howard W. Blakeslee, Science Editor for the Associated Press, recently made a special trip to Cornell to get the stories behind several activities of our faculty members in the College of Engineering. Four of these stories have been released to newspapers throughout the country to acquaint the reading public with work being done at our progressive engineering school to solve the manifold technical problems which confront the engineer.

Research in thermometers during air-conditioning experimentation at the Sibley School of Engineering led Professor Will Sawdon to announce that man's most accurate thermometers have been making errors

up to several degrees because they "feel" the radiation of the walls around them.

Another release describes a hydraulic model being used at Cornell by Professor E. W. Schoder and Mr. A. W. Vanderlip to indicate the best design for hurdles at the foot of a 127-foot power dam near Radford, Virginia. Each day's tests are telegraphed to engineers in New York where they are interpreted. In addition a 140-foot scale model dam of the Chenango River at Binghamton is being tested by Professor Schoder and Mr. Vanderlip here at Cornell to study floods that occur only about once in a hundred years.

PROFESSOR PERRY HONORED

At the annual scout dinner on January 10 which also saw the naming of President Edmund Ezra Day as honorary council president, Professor John E. Perry received the Silver Beaver award, highest honor in the Louis Agassiz Fuertes Council, Boy Scouts of America. Professor Perry, who is Scout Commissioner, also won the Scouter's Key, which was awarded at the dinner. An Assistant Professor in Railroad Engineering, he will be absent on leave during the second term.

NEW M.E. DIRECTOR

Professor William N. Barnard has been named director of the Sibley School of Mechanical Engineering in the College of Engineering by the Cornell University Board of Trustees. A graduate of Cornell in 1897, he has been, with the exception of two brief periods, a member of the faculty ever since. Since 1907 he has been professor of heat-power enigneering. He has been head of the department for eighteen years and during the past year and a half has been acting director of the Sibley School of Mechanical Engineering.

His books on heat-power engineering, written in collaboration with C. F. Hirshfeld and F. O. Ellenwood, are standard textbooks in the field, and he has published numerous studies in technical journals. In addition to teaching, he has had professional engineering experience with companies in Indianapolis, Indiana,

Professor W. N. Barnard

and Massilon, Ohio, and has frequently been called as an expert witness in patent cases. He is a member of Sigma Xi, Tau Beta Pi, Phi Kappa Phi, the American Society of Mechanical Engineers, the Society for Promotion of Engineering Education, and other honorary and professional organizations.

THE CORNELL ENGINEER is proud to announce the election of the following men to the staff:

Sophomore Business Staff:

William F. Bardo, '40 ME
James A. Frank, '40 AE
Arthur W. Harrington, Jr., '40 EE
Robert Schadler, '40 AE

Sophomore Editorial Staff:

Robert G. Irish, '40 AE
Joseph C. Marshall, '40 EE

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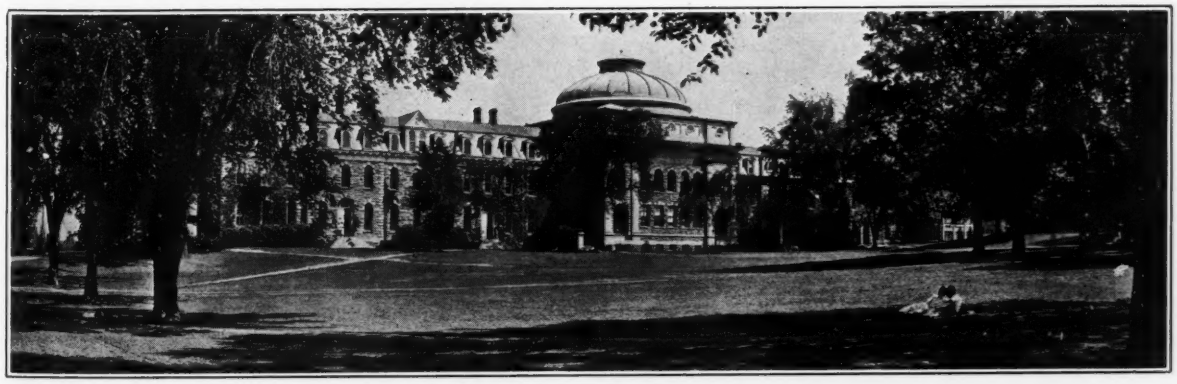

Do You Know These Men?

JOSLYN ALEXANDER SMITH

Skiing in winter and sailing in summer seem to be the main interests of Joslyn Alexander Smith, '38 EE, who is president of the Intercollegiate Ski Union. Josh however, doesn't let his outside activities interfere with his work in the Electrical Engineering School. He is a member of Tau Beta Pi and Eta Kappa Nu in addition to being Captain of the Skiing Team, a member of the Track Team, Quill and Dagger, Red Key, Mummy Club, and President of his fraternity, Alpha Delta Phi.

Smith comes from Montreal, Canada, and graduated from Philips Exter Academy where he was active both in the Musical Club and with the Track Team.

When asked what he expected to get out of college besides a degree, he replied that he expected his training here at Cornell to aid him in developing his personality and ability to get along with others. He also believes that college has taught him to think more clearly and has given him practical training in Administration.

Upon graduation, Josh intends to go into the electrical power field with a large utility company. All of his family are connected with the power industry and it is only natural that his interests should be centered in that direction. For the past two summers he has worked in the meter division of the Shawinigan Water and Power Company in Quebec where most of his work has been in testing large industrial meters.

His spare time in the summer has been spent sailing Class "C" sailboats on Lake Memphremagog in Quebec and winters he has spent skiing in the Larentian Mountains. He is a member of the famous Red Bird Ski Club which conducts all of the ski meets in Canada. As a member of the Cornell Ski Team he acted as both host and guest at the international ski meet held in the Laurentian Mountains. Another of Smith's hobbies is collecting pipes of which he has accumulated over twenty of various shapes and sizes from all parts of the world. However, he himself prefers a Comoy Pipe which is made in London.

RICHARD SMITH GOODWIN

With a fine high school record in back of him, Richard Smith Goodwin, '38 CE came to Cornell with a definite plan of making a success out of his college career and from his record we can say that he has done just that.

Dick's home town is East Liverpool, Ohio, where he attended the local high school before entering Cornell. In high school he played in both the band and orchestra and took an active part in the school dramatics.

During his Freshman and Sophomore years he continued his interest in music by playing in the R.O.T.C. Band, but in the fall of his Junior year Dick's interests turned to rowing and last season he earned his letter with the 150-pound crew.

Scholastically, Goodwin stands high in his class and as a reward he has been elected to membership in Tau Beta Pi, Chi Epsilon, Phi Kappa Phi, Sphinx Head, Rod and Bob and the Cosmopolitan Club. Not only is he a member of these societies but he also is Treasurer of Tau Beta Pi and President of Chi Epsilon.

Goodie wants to enter the field of Hydraulic Engineering when he leaves here this spring. During the last two summers he has worked for the Pittsburgh Crucible Steel Company where he has had experience in both the Engineering and Electrical Departments, but his interests are not in this type of work.

College has given him a very broad education, as he puts it, that is, development along social lines as well as experience in handling and dealing with people.

Dick loves to go camping and all of his spare time during the summer is spent in taking camping trips, playing tennis and swimming. It was the desire for outdoor life combined with a strong tendency for math which led him to choose the Civil Engineering course here at Cornell.

STRESS and STRAIN

SELENIUM FOR ALMA MATER

A mineral expert was recently solicited by the Harvard Fund. He replied as follows:

"As I am an aluminum of two other colleges besides Harvard, and can not, with my bismuth in its present state, pay antimony to all three, I hope you will not think me a cadmium if I do not ceasium this opportunity of making a donation. So far this year I have metal current expenses, but in these troubled times when the future holds in store we know not phosphorus, I could not make a contribution without boron from the bank. It would nickel out of my savings. A manganese spend his dollars these days; a tin spot is gone in no time. One is lead to feel he is pouring them down the zinc. Much better to sodium up in a stocking. But don't be silison not make any contribution this year."

The Fund wrote him simply: "Iron stand you. But as alloyman, mica suggest opening up a bromine and issuing stock certificates with the promise to selenium for dear old Alma Mater."

—Chemical and Metallurgical Eng.

Panhandler: "Say, buddy, could you let me have a buck for a cup of coffee?"

Gent: "A dollar for coffee? Preposterous!"

Panhandler: "Just tell me yes or no—but don't try to tell me how to run my own business."

—Puppet.

"Pop, what makes the world go round?"

"Listen, you little rat, stay out of that cellar!"

—Kansas Engineer.

Impatient Ida: "Quick, big boy, pinch me."

Nonchalant Ned: "To prove that you're awake?"

Impatient Ida: "No, you Sap! To prove that you are!"

—Kansas State Engineer.

"Suppose you had money," she said. "What would you do??'

He threw out his chest in all the glory of young manhood: "I'd travel."

He felt her warm young hand slide into his. When he looked up she had gone.

In his hand was a nickel.

—Illinois Technograph.

Father: "My son sure is broadminded."

Ditto: "That's all my son thinks about too."

—Indiana Bored Walk.

NOT TO BE OUTCLASSED

The Great Human Fly was slowly ascending the side of the skyscraper. As he reached the fortieth floor he heard cries of alarm and looking down he beheld a drunk almost directly behind him.

"Get back there, you fool!" he yelled. "You can't do this trick!"

The drunk thumbed his nose at him.

The Great Human Fly shrugged his shoulders and continued on. Up, up he went past the fiftieth, past the sixtieth story, until he reached the top. He climbed over the parapet and sank exhausted on the roof; then he felt something heavy fall on top of him and discovered it was the drunk who had followed him.

His professional jealousy was outraged. The drunk grinned "I c'n do anything you can do!"

The Great Human Fly laughed with a sneer. "Oh yeah?" he cried. "Well, let's see you do this!"

With a terriffic leap he cleared the parapet and opening his parachute floated toward the ground. Half way down he heard a chorus of shrieks and looking up he saw the drunk coming after him hell bent for election. As he passed him the drunk yelled, "Sissy!"

—Kansas Engineer.

Here's something to add a little life to a dead hour. It's called Merrygoround and starts out like this:

"You look like the man."
"What man?"
"The man with the power."
"What power?"
"The power of Hoo-Doo?"
"Hoo-Doo?"
"You do."
"Do what?"
"Look like the man."
"What man?"
etc.

—Rose Technique.

ALUMNI NOTES

'91 MME—Clarence Linus Cory passed away August 2, 1937 in Agnew, Cal. He had been Professor of Electrical Engineering at the University of California since 1892 and Dean of the College of Mechanics from 1901 until his retirement in 1930. He had also been in practice as a consulting electrical and mechanical engineer in San Francisco since 1899. During 1917 and 1918 he was Assistant Director of the United States explosive plants, in charge of electric power supply.

'94 CE—Elon H. Hocker presided as Chairman of the Executive Board of the Research Corporation of New York at a recent dinner at New York City at which the corporatoin awarded plaques and $2,500 each to Professor Bridgeman of Harvard and E. O. Lawrence of University of California in recognition of their research in physics.

'95 ME—Ernest M. Gilbert is president of the Gilbert Engineering Corporation. His offices include presidency and directorship of Utilities Purchasing and Supply Corporation and Management Holding Corporation, presidency of York Haven Electric Transmission Co., directorship of Lexington Water Power Co., Columbia, S. C., and Municipal Service Co., presidency of Berks County Chapter of the American Red Cross, vice-presidency and directorship of the Berks County Trust Co., Reading, Pa., and directorship of the Reading Hospital. He lives in Reading at 412 Washington Street.

'96 ME—Carlos W. VanLaw is with the Pardner's Mines Corporation, 405 Lexington Avenue, New York City.

'99ME—Harry A. Hageman's promotion to chief hydraulic engineer of the TVA, Knoxville, Tenn., has just been announced. He is living at the Hotel Arnold, in Knoxville, Tenn.

C. F. Hirshfeld, '03 gave a paper at the A.S.C.E. Convention in New York City on "Cost of Heat-Generated Energy". Mr. Hirshfeld is a former member of the faculty of the Engineering College and is now with the Detroit Edison Company in Detroit.

'03-'04 ME—Arthur L. Jones was appointed in December a commercial vice president of the General Electric Company. With General Electric since graduation, he has been in Denver, Colo., since 1907.

'04 CE—Ross M. Riegel, 3327 Glenfield Drice, Knoxville, Tenn., is head civil engineer of the design department of the T. V. A.

'05 ME—Wetmore H. Titus is a sales engineer representing the American Steam Pump Company in Philadelphia, Pa. He has a fourteen year old son, James W., and lives at 312 Kent Road, Bala-Cynwyd, Pa.

'07 ME—Henry J. Miller is vice president and secretary of the Pittsburgh Steel Co., Pittsburgh, Pa.

'08 ME—Thomas M. Jackson, chief electrical and welding engineer for the Sun Shipbuilding and Dry Dock Company, Chester, Pa., has been awarded the Lincoln Gold Medal of the American Welding Society. He is the author of the best paper in the Society's journal during the past year, entitled "Welding in Tanker Construction."

'08 ME—Charles B. Goodspeed, as treasurer of the Republican National Committee, is faced with eradicating the current deficit of about $1,000,000. A manufacturer, with offices at 619 Railway Exchange Building, Chicago, Ill., he is also member-at-large of the board of directors of the Cornellian Council.

'09, '10 ME—Walter L. Bartholomew who lives at 520 Kings Highway, Moorestown, N. J. is production manager of the board mill of MacAndrews and Forbes Company, Camden, N. J. He has three sons, one a freshman in the University.

'10 MS—Jerome A. Fried of Ithaca after waiting for three years, recently received word of the issuance of a patent on a governor for electric motors. This governor which is a feature of the Allen-Wales adding machine, is designed to work in a constricted space at a very low speed. In issuing the patent on this device, which is the basic principle involved in electrically operated adding machines, the government also allowed fourteen claims for unique features.

John C. Page, '10-'11 is now commissioner of the U. S. Bureau of Reclamation. At the recent A.S.C.E. Convention in New York City, he gave a paper on the "Elements of power Cost".

'11 ME—Edgar MacNaughton, professor in charge of the mechanical engineering department at Tufts College, has moved from Sumerville, Mass., to 61 Ravine Road, West Medford, Mass. He was recently elected to the executive committee of the American Society of Mechanical Engineers.

'12 ME—Earl F. Tucker is with the United States Bureau of Reclamation, Boulder City, Nev., where he lives at 1333 Denver Street.

12 CE—Hollister Johnson is with the United States Geological Survey, Box 948, 526 Federal Building, Albany, N. Y.

'12 ME—John B. Johnson is chief of material section, material division of the Air Corps, USA, Wright Field, Dayton, Ohio.

'13 MCE—Francis M. Dawson, formerly a professor of hydraulics at the University of Wisconsin, is now dean of engineering at the State University of Iowa, Iowa City, Iowa.

'13, '14 ME—Alfred C. Day of 136 Waverly Place, New York City, writes as follows: "I am a manufacturer of burlap and cotton bags. On April 16, I resigned my commission as lieutenant-colonel of the Chemical Warfare Service, Reserve, and accepted the appointment as lieutenant colonel, CWS, New Jersey National Guard, assigned as chemical officer of the staff of the 44th Division.

'15 CE—Edwin C. Baker has recently moved his offices to 1339 Guardian Building, Cleveland. Ohio. He is president this year of the Cornell Club of Cleveland; and president of the A. B. Smythe Company, real estate brokers, and a trustee and treasurer of the Cleveland Real Estate Board.

'18 ME—August Schmidt was recently granted a patent by the United States on a system of electrical distribution. The patent was assigned to the General Electric Company.

'21 EE—C. E. Fiske is a member of the president's staff of the Consolidated Gas, Electric Light and Power Company, Baltimore, Md. where he lives at 407 Wingate Road.

'21 CE—Robert L. Quick married Eva M. Ricker of Ithaca on December 31. They will reside at 40 Maple Avenue, Pulaski, where Quick is with the National Park service.

'22 ME, MS—K. D. Wood, former Assistant Professor in Mechanical Engineering at Cornell is now Professor of Aeronautics at Purdue University. He left Cornell in 1936 to join Consolidated Aircraft as full time aerodynamicist and spent most of his time supervising wind tunnel tests at Cal Tec in Pasadena. He has written three textbooks on airplane design.

'23, '25 ME—Benjamin W. Robinson is with the American Steel and Wire Company, 350 Fifth Avenue, New York City; his home address is 128 Marine Avenue, Brooklyn.

'25, '28 EE—Clarence A. Martin, Jr. is an engineer with the New Jersey Bell Telephone Company, 540 Broad Street, Newark, N. J. His home is at 30 Grove Place, East Orange.

'25 ME—George T. Ladd, president of United Engineering Foundry Company, is a trustee of Follansbee Brothers Co., 50 Church Street, New York City.

'26 ME—Thomas W. Pew is vice-president and general manager of General Crude Oil Co., Esperson Building, Houston, Texas.

'26 EE—William A. Carran, Jr., is president of Valley Oil Company and Solor Products Company, and vice-president and treasurer of Central Petroleum Company. He is married to Marguerite L. Pigott '24, and has two daughters. They are living at 3268 Belvoir Boulevard, Beachwood, Warrensville, Ohio.

'26 ME—T. C. Ingersoll is with the Bethlehem Shipbuilding Corporation, San Francisco, Cal. His home is at 1802 Highland Place, Berkley.

'27 ME—H. E. Wheeler is with the M. W. Kellogg Company of New York City, and lives at 405 West 23rd Street.

'27 MCE—Fag M. Raymond has left the U. S. Engineers Office and is now a Consulting Engineer with offices at 846 Landers Bldg., Springfield, Mo.

'28 CE—Mr. and Mrs. Lewis Littlepage have announced the marriage of their daughter, Dorothy Via., to Mr. Gibson Milton Allen on Saturday, Jan. 1st, 1938 at Norfolk, Va. The newlyweds will be at home after January 15th at 215 Walnut Lane, Germantown, Pa.

'28 ME—J. F. Nelles married Catherine Carr of Maplewood, N. J. in July. They now live at 116 Coolidge Street, Irvington, N. J.

'28 ME—Henry C. Boschen, construction engineer with the Raymond Concrete Pile Corp., 140 Cedar Street, New York City, writes, "I am located in Barranquila and Cartegena, Columbia, in connection with the construction of a maritime terminal in the former and a city water supply in the latter city.

'29 CE—William B. McLean married Roberta Hall, Smith College alumna. McLean is with the Bethlehem Steel Co. in Bethlehem, Pa.

'32 CE—Markoe O. Kellogg is a draftsman in the office of the Engineer-in-Charge of the New England Region of the Sun Oil Company. His address is 175 Newberry Street, Boston, Mass.

'32 MCE—"Chitty Ho is now director and chief engineer of the Chekiang Conservancy Bureau at Hangchow, China. He was previously Professor of Hydraulic Engineering and Experimental Hydraulics at Pei-Yang University, Teintsin, China," according to an extract from *Civil Engineering*.

E. B. Isaaks, '35, is now associated with Madigan and Hyland, consulting engineers of New York City. He recently spent two months in California in connection with some work on the San Francisco Oakland Bridge. Mr. Isaaks is a former member of the CIVIL ENGINEER Board.

'36 CE—Since November 1936, John J. Gillespie has been employed as an engineer with the Southern California division of General Motors Corporation. His address is 44 Esperanza Avenue, Long Beach, Calif.

'36 AE—George B. Wright is with the Diamond State Telephone Company. He has moved from Wilmington to Seaford, Del., where he lives at the Sussix Hotel.

'36 ME—Parker A. Stacy Jr. is taking graduate work in the field of aeronautics at the California Institute of Technology.

CORNELL SOCIETY *of* ENGINEERS

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WALKER L. CISLER '22, EXECUTIVE VICE PRESIDENT — ELWYN E. SEELYE '04, SECRETARY-TREASURER

DAVID HARMON '31, RECORDING SECRETARY

•

"The objects of this Society are to promote the Welfare of the College of Engineering at Cornell University, its graduates and former students and to establish a closer relationship between the college and the alumni."

President's Column

February 2, 1938.

Fellow Engineers:

Experiences in interviewing a large number of engineers seeking jobs in a private engineering office, in conducting civil service examinations for the State of Maryland and the City of Baltimore, and in talking with and registering needy, unemployed engineers during the depression years of the early thirties, have convinced me that the average engineer out of a job is timid, self-conscious, uncommunicative, unassertive, lacks respect for his own ability, speaks in a hesitating voice and with not-too-good English, and hasn't fortified himself by rehearsing beforehand his list of qualifications nor inquired into, to any great extent, the particulars of the place he seeks.

Engineers, even experienced ones, will walk into the office of an employer and begin the conversation by asking for a job or by producing a letter of reference. From this point on the employer must ask questions to elicit the applicant's education, training, experience and with whom he has previously worked. At last the information is dragged forth that the applicant has some specialized knowledge on the problems being studied at the time by the employer and the conversation becomes more interesting for all parties concerned.

The merest beginner in salesmanship will condemn the above-described approach to a job as being utterly wrong. If the answer to the asking for a job is in the negative, the interview is at an end and the applicant walks out. If the employer himself has to pry out the applicant's engineering knowledeg, then his is the work of finding the talent to fill his needs and the pay will be less because of the lack of initiative on the part of the applicant.

In a recent examination of some thirty engineers they were asked to write out their education, training and experience, including "experience in connection with public utility work." Not one of them made mention of even having paid their gas or telephone bills, and it was only in the personal interview that it was ascertained most of them had had considerable experience with public utilities, such as providing space in the streets for mains and ducts and in laying out electric circuits for pumping stations, etc. The oversight on the part of these men in not seeing that they presented their full experience can be laid to carelessness or to dimness of perception, both inexcusable.

The interviewing and registering of destitute unemployed engineers during the depression was really heart-breaking. Men would write down that they were "surveyors," which general classification covers anything from rodman on a farm survey party to resident engineer on a construction project. It was mainly by the alertness and intelligence of our registration agent that we obtained a proper concept of the various abilities and specialties of the unemployed engineers so as to be provided with the necessary information to get them suitably niched into jobs.

George M. Kellar, ME. '09, a number of years ago sought a job with an automobile company. Instead of first going to the employment office, he made friends with one foreman and spent several days in observing motions on the assembly lines. He then went to

(*Continued on page* 138)

OF INTEREST TO TELEPHONE USERS

I think many people have only a vague idea of how our company functions within the Bell System, and how a unique business philosophy is operating to make your telephone service increasingly dependable and economical. This advertisement is the briefest possible statement of the philosophy that guides the Western Electric Company.

PRESIDENT

In 1882 the Bell System became convinced that the best way to assure uniformity of equipment necessary for universal telephone service was to control its manufacture through *one* organization. To this end it acquired the Western Electric Company, which operates under this three-fold policy:

1. *To make telephone apparatus of high quality.*

This in itself is not unusual. What *is* unusual is that every item of equipment in the vast network of the Bell System must coordinate so perfectly that from any Bell telephone you can talk clearly with any one of the millions of others. Can you think of any other product which must meet such an extraordinary test?

2. *To work for efficiency and lower costs.*

Whether it be in purchasing materials—or in manufacturing the 43,000 items of telephone apparatus—or in distributing all this equipment to the Bell companies, Western Electric is always seeking the better way. As a result it has a progressive record of methods developed, products improved, economies effected, and costs lowered.

3. *To keep prices at the lowest possible level consistent with financial safety.*

Western Electric furnishes most of the telephone equipment used by the operating companies of the System. By combining their requirements it is able to manufacture more economically; and it eliminates selling expenses and credit losses. The resulting savings it passes along to its telephone customers in the form of lower prices.

On these sales the policy of the Company is to set the lowest prices which will enable it to pay fair wages to its employees, to earn a fair return on the money invested in the business, and to maintain the Company's financial stability.

This policy of voluntarily limiting profits is reflected in the Company's financial record. In recent years it has earned on its investment a rate of return only about half as large as that of a representative group of comparable manufacturers, and over a period of twenty years this rate has averaged less than 7%.

This set-up within the Bell System results in low costs to your Telephone Company, and thus Western Electric contributes its part in making Bell Telephone service dependable and economical.

Western Electric

BELL SYSTEM SERVICE IS BASED ON WESTERN ELECTRIC QUALITY

(*Continued from page* 136)

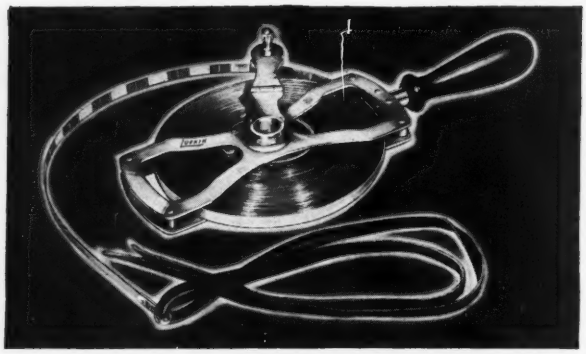
a vice-president of the company and convinced him that by several minor changes he could save a number of man-hours of work per car. The point I wish to make with this story is that George did not have to ask for a job after he showed his prospective employer that he had an intelligent knowledge of the company's problems.

If a man comes into an office engaged in designing a bridge and tells of his experience in the detailing of items such as the drainage of rocker shoe recesses or the results of tests on expansion and movement in some existing bridge structure, the employer would be much more interested in giving him a job than in a man who came in to take part in an interview such as that described in the first part of this article.

More and more the modern trend is for specialized knowledge in engineering and an applicant should stress his specialties when he applies for a job or in the competition of keeping the job.

This, then, is a plea for Cornell engineers to be careful when going after work. Know your abilities and exercise judgment in describing them.

G. J. REQUARDT, *President,*
Cornell Society of Engineers.



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When you choose a Lufkin "Michigan" chain tape you've chosen a tape that's built for hard service. The markings are deeply stamped in long-wearing Babbitt metal. The sturdy dull-nickeled reel effectively resists weather and wear. Every part of a Lufkin "Michigan" tape—frame, tape-line, handle and even the brass end-clips and leather thongs are designed and built for hard use. And records of their performance prove they can "take it." See your nearest dealer or write for free illustrated catalog No. 12.

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TAPES — RULES — PRECISION TOOLS

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Life Insurance is one of the Outstanding Investments which, as the Years pass by, Advances in Value

During the past 38 years, over 1000 chrifty Cornell Agricultural students have created estates in excess of $5,000,000 by buying life insurance and annuity policies from the

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For further information regarding a guaranteed life income beginning at age of 60 or 65,

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ETA KAPPA NU ACTIVITIES

The members of the honorary electrical engineering society, Eta Kappa Nu, have a helpful employment service in operation which has materially aided in placing electrical engineering graduates in jobs. Planning for this year's graduates was the main subject discussed at the meeting of the society on Tuesday, January 25, when the new members attended their first business meeting.

Questionnaires are sent out to organizations likely to have employment for electrical engineers, and the society thereby gets a list of possible openings. At the same time it brings to the attention of company representatives the fact that Cornell has a supply of talent to offer in the form of electrical engineering graduates.

A.S.C.E. MEETING

How the American Society of Civil Engineers is co-operating in a nation-wide program of aerial surveys was discussed at a recent meeting of the Ithaca Section of the A.S.C.E attended by 35 men from Elmira, Corning, Montour Falls, and Ithaca. Professor P. H. Underwood of the School of Civil Engineering reported the progress of the plan as it affects New York State. The Ithaca section is co-operating with the New York State Planning Commission in establishing a system of plane coordinates, or accurate lines across the state from north to south and east to west, so that all aerial surveys for public works can be placed in proper reference to the entire area. The national program has been recommended by the U. S. Coast and Geodetic Survey.

The modern methods and equipment used in making aerial surveys and maps was described by the guest speaker, C. S. Robinson of Ithaca, at the meeting on January 26. Lantern slides were used to illustrate the talk.

The Section's Advisory Committee on Salaries is acting with the General Committee on Salaries, which is making a comprehensive study with the purpose of recommending a uniform scale to employing agencies. Professor Carl Crandall, chairman of the local section's committee, reported that engineers in the New York State service were now employed on an improved salary scale basis, which was made imperative by legislation passed at the last session of the legislature.

The Ithaca Section with headquarters in Lincoln Hall, was organized on February 10, 1932, by members of the American Society of Civil Engineers residing in Binghamton, Elmira, and Ithaca. The Section has had a steady increase in membership since its beginning. In its six years of existence, the Section has sponsored some forty-five lectures which have covered all fields of Civil Engineering and allied subjects. The next meeting of the Section will be held on Feb. 24th when Mr. H. C. Tammen, engineer from New York City, will describe the construction of a bridge across the Neches River at Port Arthur, Texas.

OKONITE INSULATION

OKONITE insulation with an unsurpassed record since 1878 is still generally recognized as the acme of perfection for rubber insulations and as "the best product possible" of its type.
The Okonite Company and its affiliates, however, have constantly kept step with the advances of the electric art.

Whether the wire or cable is large or small, single or multiple conductor, high or low voltage, whether finished with a rubber or a synthetic compound jacket, braid, lead sheath or armor of any type, Okonite can make it.

In all cases, whether the correct solution calls for rubber, impregnated paper, varnished cambric, asbestos, glass or the newer synthetic compounds, the policy still is and will continue to be *the best product possible.*

THE OKONITE COMPANY
Founded 1878
HAZARD INSULATED WIRE WORKS DIVISION
THE OKONITE-CALLENDER CABLE COMPANY, INC.
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Stress & Strain

When you see a lady go
Slim and supple as a doe
Wearing satin cut to fit
As if madame were poured in it;
When you almost lose your mind
Notice how it clings behind
And notice how the lovely curves before
Invite attention more and more;
When, thus you stand, romantic, mad,
Take your warning from an Ad:
Be shure this vision that you see
Is not the work of corsetrie.
Be sure that all these curves are truly
Acts of God and not unduly
Brought about by man's worst foe
That two-way stretching so-and-so.

—D. A . C. News

* * *

The following convervation ensued between a hungry Irishman and a resturaunt waiter one Friday:

"Have yez any whale?"
"No."
"Have yez any shark?"
"No."
"Have yez any jellyfish?"
"No."
"Have yez any swordfish?"
"No."
"Then bring me ham and eggs and a beefsteak smothered with onions. The Lord knows I asked for fish."

—Arkansas Engineer

* * *

There is nothing strange about the saying that the modern girl is a "live-wire." She carries practically no insulation.

—Washington State Engineer

* * *

Bob Walker: Your lipstick is coming off.
Betty: No it isn't.
Bob: It is.
Betty: I'm sure it isn't.
Bob: Listen, any time I get as close as this to a girl, her lipstick IS coming off.

—Illinois Technograph

* * *

Taxi driver: "I take the next turn, don't I?"
Voice from rear seat: "Oh Yeah!"

—Nebraska Blue Print

SUB-ZERO DEPENDABILITY

The toughness of steel at low temperatures is a vital factor in the performance of many different types of machines. Just for example, hundreds of motor vehicles must operate every winter at temperatures that make good sub-zero impact strength in highly stressed parts a necessity.

Molybdenum steels, when properly heat-treated, have excellent impact properties at low temperatures. Investigation shows that they retain their toughness remarkably, even at temperatures as low as —90° F. Consequently, Molybdenum steels offer great possibilities for the manufacturer of equipment that must work either continuously or intermittently at low temperatures. Advantage can be taken of their established price and fabricating economy, with perfect assurance of their performance.

We will be glad to send detailed information on the low-temperature impact properties of several widely used Molybdenum steels to any one interested. Climax Molybdenum Company, 500 Fifth Avenue, New York City.

PRODUCERS OF FERRO-MOLYBDENUM, CALCIUM MOLYBDATE AND MOLYBDENUM TRIOXIDE

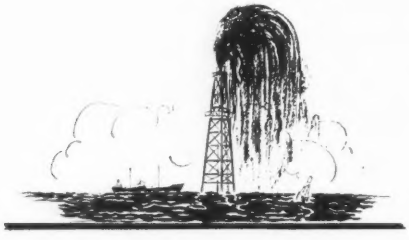
CLIMAX MO-LYB-DEN-UM COMPANY **MOLY**

G-E *Campus News*

TEST ALUMNI DAY

TO celebrate the third annual reunion of engineering graduates of General Electric Test, men all over the world gathered in groups to listen to the international radiobroadcast of the reunion at Schenectady, N. Y. Officers and prominent members of P.T.M., or Past Test Men's Association, sent greetings to their fellow Testmen over the General Electric shortwave stations, W2XAD and W2XAF. More than 15,000 men have graduated from G-E Test—a course which enables them to supplement

their theoretical knowledge with a practical training. Test graduates today hold many responsible positions in the Company. Others have gone into every walk of life—engineers, lawyers, utility executives, farmers, industrial leaders, bankers, and many other professions. There is, however, one tie which binds them all—their experience "on Test," and to many of them that experience is recalled with somewhat the same enthusiasm as days in college.



OIL FROM WATER

DOWN on the shores of Lake Maracaibo in the steaming jungles of Venezuela, the Dutch Shell Company owns rights to a fifty-mile frontage. Here it has drilled hundreds of wells to make available the rich oil found in deposits ranging from 1500 to 5000 feet below the lake surface.

The natural gas which accompanies the oil deposits has for years been used to power the wells. In spite of this cheap source of power, General Electric engineers under the supervision of E. E. Thomas, Kansas State '22, were able to convince officials of the Dutch Shell Company that it would be more economical in the long run to use electricity instead of natural gas and gas engines for operating power. As a result, a high-voltage line will be erected along the lake shore, from which step-down transformers will distribute current to the motors in the producing areas.

The Lago Petroleum Company has wells in a section paralleling the Dutch properties and extending ten miles out in the lake, which has already been electrified. The combination of these two companies makes the largest electrified system of its kind in the world, from which 400,000 barrels of oil are shipped daily to refineries in Aruba and Curacao, N.W.I.

WHISTLING GASES

GASES are liquefied to be used as cooling agents and to conserve storage space. Chester W. Rice, Harvard '10, consulting engineer in the Schenectady Works of the General Electric Company, has developed a method of thus processing gases more readily by making them whistle.

To liquefy a gas by this method, it is necessary to compress it to 3,000 pounds per square inch, cool it, and pass it through a series of tubes into a liquefying chamber where the pressure is released through a valve in the form of a whistle, producing a further escape of heat energy. Mr. Rice's whistle is so pitched as to convert the greatest amount of heat energy into sound energy. To be effective, however, the sound energy must be carried away from the liquefying chamber.

Developments such as this are being made by college graduates who were at one time "on Test." Many of them have been off the college campus but a few years and are entering a career in one of the many business and engineering fields in the General Electric Company.

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